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Scaffold of decellularized human dermis for cardiac repair and regeneration

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Skin shares properties of elasticity with muscular tissue. Since elasticity is mostly conferred by muscle cells or elastic fibers, after decellularization the removal of muscle cells causes in decellularized muscles loss of such property, while decellularized skin retains elasticity as skin ECM is rich in elastic fibers that are retained after decellularization. Additionally, mechanic properties are fundamental to ensure myocyte differentiation1 and alignment in myocardium. We developed a fast and efficient protocol of decellularization for human skin using skin fragments from patients undergoing plastic surgery. After decellularization, content of elastin was quantified by quantitative dye-binding method. Additionally elastin content and distribution was evaluated on histological sections by Paraldehyde Fuchsin Gomori and Weigert Van Gieson stainings. Decellularized Human Skin (d-HuSk) obtained was then sectioned into 600um thick sections and used as scaffold to prepare three-dimensional culture of cardiac primitive cells (CPCs). We evaluated, then, CPC survival and ability to differentiate, in vitro, towards cardiomyocytes at gene and protein level when cultured on d-HuSk. Decellularization procedure yielded the acellular extracellular matrix (ECM) with preserved tissue architecture, named d-HuSk. Importantly, histological and quantitative analysis clearly showed the retention of elastic fibers by d-HuSk. CPCs seeded on d-Husk engrafted and survived, and their ability to differentiate towards cardiomyocytes was not lost, as shown by preserved expression of markers specific for cardiac muscle cells, both at protein and gene level. Such results suggest that common signals and properties act both in cardiac and skin microenvironment, making skin a potential powerful and off-the-shelf biological scaffold for cardiovascular regenerative medicine. Although emerging from an in vitro study, the evidence that progenitors of cardiac muscle lineage retain the ability to differentiate on biological scaffold obtained from different, more easily accessible, anatomic site, represents an important advance in cardiovascular regenerative medicine. Specifically, d-HuSk is an alternate biological scaffold that overcomes problems related to the preparation of myocardial biological scaffolds.

Key words

Cardiac regeneration, Decellularized-ECM, Biological scaffold.